

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

EP 1 351 530 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
08.10.2003 Bulletin 2003/41

(51) Int Cl.7: H04Q 7/30, H04L 12/28

(21) Application number: 03015799.4

(22) Date of filing: 17.11.2000

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE TR

(62) Document number(s) of the earlier application(s) in  
accordance with Art. 76 EPC:  
00125076.0 / 1 207 708

(71) Applicant: TELEFONAKTIEBOLAGET LM  
ERICSSON  
126 25 Stockholm (SE)

(72) Inventors:  
• Vilkberg, Jari T.  
152 52 Södertälje (SE)  
• Gjärdman, Jan A.  
123 52 Farsta (SE)

- Hallenstal, Magnus  
187 50 Täby (SE)
- Furtenback, Ros-Marie  
121 36 Johanneshov (SE)
- Nylander, Tomas  
130 37 Stavsnäs (SE)
- Hänström, Martin  
145 60 Norsborg (SE)

(74) Representative: Gray, Helen Mary et al  
Aliblins GmbH  
Grasserstrasse 10  
80339 München (DE)

### Remarks:

This application was filed on 10 - 07 - 2003 as a  
divisional application to the application mentioned  
under INID code 62.

### (54) A mobile communication network

(57) A mobile telecommunications network includes an access network portion (10') adapted to communicate with a core network portion (20) of a public mobile telecommunications network and with mobile terminals (1). The access network includes at least one base station (104) adapted to communicate with the mobile terminals via an unlicensed radio link and an access control part connected to the core network portion. The base station is connected to the access control part via a fixed broadband network. The invention concerns a connecting a base station with an access control part of an access network over a fixed broadband network, and a method of registering a base station with an access control part over the fixed broadband network.

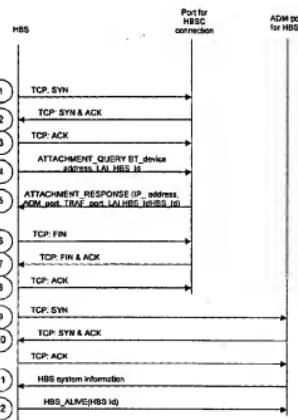


Fig. 2

**Description**Field of invention

**[0001]** The invention concerns mobile communication networks, with specific relevance to mobile telephone networks and the transition between fixed and mobile telephony services.

Background art

**[0002]** Mobile communication is becoming increasingly widespread as the number of available services multiply. However the higher billing costs associated with most mobile networks and also the often inferior reception of mobile signals inside some buildings mean that subscribers generally prefer to retain a fixed telephone access in the home or a place of business. The types of services and also the way in which these services are presented differ depending on whether the subscriber is using a mobile phone or a fixed phone. This can range from the provision of completely different services, such as SMS, to the manner in which an address book is used. Moreover, subscribers to mobile and fixed phone networks will generally have different subscriptions and thus different phone numbers. Indeed in many countries, a reliable fixed access to telecommunication services is provided by only a single operator. A subscriber to both a mobile and fixed telephone network will therefore be obliged to adapt the manner in which he uses the fixed and mobile sets.

**[0003]** A presently available service uses a single handset that combines a GSM terminal with a cordless handset for accessing a fixed network. The handset can access the fixed network, for example via a PBX in a corporate facility, using a digital enhanced cordless telecommunications (DECT) system. When the handset passes out of range of the PBX base station the handset communicates with the GSM network. The user has both a fixed and a mobile subscription and also has separate numbers associated with these subscriptions. This allows the user to retain the use of a single phone, however, the services available will depend on whether the phone is being used as a GSM terminal or cordless handset. The phone is also large compared to conventional mobile terminals since it essentially consists of a GSM terminal arranged back to back with a DECT handset.

**[0004]** It is thus an object of the present invention to provide an improved communication network that alleviates the problems of prior art arrangements.

**[0005]** It is a further object of the present invention to provide a communication network and network elements that enable a uniformity of service whether a subscriber uses a fixed or mobile access to telecommunication services.

**SUMMARY OF INVENTION**

**[0006]** These and further objects are attained in a mobile telecommunications network having an access network portion and a core network portion. The access network portion includes an access control part that is arranged to communicate with the core network portion over a predetermined licensed mobile network interface, such as an A interface for GSM or Iu interface for UMTS. The access network portion also includes one or more base station parts that are arranged to communicate with mobile terminals over an unlicensed radio interface and also a fixed broadband network connecting the access control part and the base station parts.

**[0007]** The invention resides in a method of connecting a base station with an access control part of an access network over a fixed broadband network, and a method of registering a base station with an access control part.

**[0008]** By providing access to the public mobile network service through an unlicensed radio interface, that by definition will be low power and have a small range compared to conventional access networks such as the base station subsystem BSS in GSM or UTRAN in UMTS, and by relaying upper layer messages in a transparent manner, i.e. without mapping or similar interworking, the same service and subscription can be retained by the subscriber without perceiving a difference in the level and presentation of service obtainable. Moreover, the voice quality in the home or office environment is greatly improved by the local coverage. The battery lifetime of his mobile terminals will also be greater than when it is used uniquely with conventional access networks. In addition, a public mobile network operator would be able to offer a fixed access service without the need for additional cell planning.

**[0009]** Advantageously, the connection between the base station part and the access controller part exploits an already existing broadband fixed network available to the subscriber at his home or workplace. This network may be a cable TV network, or ADSL network, but is preferably IP based so that the interface between the access network elements is independent of the physical network type. In an alternative embodiment the fixed network may be an ATM-based network. In particular, DSL type networks could run over ATM directly. Other technologies could be run on an ATM-based network on top of IP.

**[0010]** The invention may also concern the following aspects:

50  
55  
59  
64  
69  
74  
79  
84  
89  
94  
99  
104  
109  
114  
119  
124  
129  
134  
139  
144  
149  
154  
159  
164  
169  
174  
179  
184  
189  
194  
199  
204  
209  
214  
219  
224  
229  
234  
239  
244  
249  
254  
259  
264  
269  
274  
279  
284  
289  
294  
299  
304  
309  
314  
319  
324  
329  
334  
339  
344  
349  
354  
359  
364  
369  
374  
379  
384  
389  
394  
399  
404  
409  
414  
419  
424  
429  
434  
439  
444  
449  
454  
459  
464  
469  
474  
479  
484  
489  
494  
499  
504  
509  
514  
519  
524  
529  
534  
539  
544  
549  
554  
559  
564  
569  
574  
579  
584  
589  
594  
599  
604  
609  
614  
619  
624  
629  
634  
639  
644  
649  
654  
659  
664  
669  
674  
679  
684  
689  
694  
699  
704  
709  
714  
719  
724  
729  
734  
739  
744  
749  
754  
759  
764  
769  
774  
779  
784  
789  
794  
799  
804  
809  
814  
819  
824  
829  
834  
839  
844  
849  
854  
859  
864  
869  
874  
879  
884  
889  
894  
899  
904  
909  
914  
919  
924  
929  
934  
939  
944  
949  
954  
959  
964  
969  
974  
979  
984  
989  
994  
999  
1004  
1009  
1014  
1019  
1024  
1029  
1034  
1039  
1044  
1049  
1054  
1059  
1064  
1069  
1074  
1079  
1084  
1089  
1094  
1099  
1104  
1109  
1114  
1119  
1124  
1129  
1134  
1139  
1144  
1149  
1154  
1159  
1164  
1169  
1174  
1179  
1184  
1189  
1194  
1199  
1204  
1209  
1214  
1219  
1224  
1229  
1234  
1239  
1244  
1249  
1254  
1259  
1264  
1269  
1274  
1279  
1284  
1289  
1294  
1299  
1304  
1309  
1314  
1319  
1324  
1329  
1334  
1339  
1344  
1349  
1354  
1359  
1364  
1369  
1374  
1379  
1384  
1389  
1394  
1399  
1404  
1409  
1414  
1419  
1424  
1429  
1434  
1439  
1444  
1449  
1454  
1459  
1464  
1469  
1474  
1479  
1484  
1489  
1494  
1499  
1504  
1509  
1514  
1519  
1524  
1529  
1534  
1539  
1544  
1549  
1554  
1559  
1564  
1569  
1574  
1579  
1584  
1589  
1594  
1599  
1604  
1609  
1614  
1619  
1624  
1629  
1634  
1639  
1644  
1649  
1654  
1659  
1664  
1669  
1674  
1679  
1684  
1689  
1694  
1699  
1704  
1709  
1714  
1719  
1724  
1729  
1734  
1739  
1744  
1749  
1754  
1759  
1764  
1769  
1774  
1779  
1784  
1789  
1794  
1799  
1804  
1809  
1814  
1819  
1824  
1829  
1834  
1839  
1844  
1849  
1854  
1859  
1864  
1869  
1874  
1879  
1884  
1889  
1894  
1899  
1904  
1909  
1914  
1919  
1924  
1929  
1934  
1939  
1944  
1949  
1954  
1959  
1964  
1969  
1974  
1979  
1984  
1989  
1994  
1999  
2004  
2009  
2014  
2019  
2024  
2029  
2034  
2039  
2044  
2049  
2054  
2059  
2064  
2069  
2074  
2079  
2084  
2089  
2094  
2099  
2104  
2109  
2114  
2119  
2124  
2129  
2134  
2139  
2144  
2149  
2154  
2159  
2164  
2169  
2174  
2179  
2184  
2189  
2194  
2199  
2204  
2209  
2214  
2219  
2224  
2229  
2234  
2239  
2244  
2249  
2254  
2259  
2264  
2269  
2274  
2279  
2284  
2289  
2294  
2299  
2304  
2309  
2314  
2319  
2324  
2329  
2334  
2339  
2344  
2349  
2354  
2359  
2364  
2369  
2374  
2379  
2384  
2389  
2394  
2399  
2404  
2409  
2414  
2419  
2424  
2429  
2434  
2439  
2444  
2449  
2454  
2459  
2464  
2469  
2474  
2479  
2484  
2489  
2494  
2499  
2504  
2509  
2514  
2519  
2524  
2529  
2534  
2539  
2544  
2549  
2554  
2559  
2564  
2569  
2574  
2579  
2584  
2589  
2594  
2599  
2604  
2609  
2614  
2619  
2624  
2629  
2634  
2639  
2644  
2649  
2654  
2659  
2664  
2669  
2674  
2679  
2684  
2689  
2694  
2699  
2704  
2709  
2714  
2719  
2724  
2729  
2734  
2739  
2744  
2749  
2754  
2759  
2764  
2769  
2774  
2779  
2784  
2789  
2794  
2799  
2804  
2809  
2814  
2819  
2824  
2829  
2834  
2839  
2844  
2849  
2854  
2859  
2864  
2869  
2874  
2879  
2884  
2889  
2894  
2899  
2904  
2909  
2914  
2919  
2924  
2929  
2934  
2939  
2944  
2949  
2954  
2959  
2964  
2969  
2974  
2979  
2984  
2989  
2994  
2999  
3004  
3009  
3014  
3019  
3024  
3029  
3034  
3039  
3044  
3049  
3054  
3059  
3064  
3069  
3074  
3079  
3084  
3089  
3094  
3099  
3104  
3109  
3114  
3119  
3124  
3129  
3134  
3139  
3144  
3149  
3154  
3159  
3164  
3169  
3174  
3179  
3184  
3189  
3194  
3199  
3204  
3209  
3214  
3219  
3224  
3229  
3234  
3239  
3244  
3249  
3254  
3259  
3264  
3269  
3274  
3279  
3284  
3289  
3294  
3299  
3304  
3309  
3314  
3319  
3324  
3329  
3334  
3339  
3344  
3349  
3354  
3359  
3364  
3369  
3374  
3379  
3384  
3389  
3394  
3399  
3404  
3409  
3414  
3419  
3424  
3429  
3434  
3439  
3444  
3449  
3454  
3459  
3464  
3469  
3474  
3479  
3484  
3489  
3494  
3499  
3504  
3509  
3514  
3519  
3524  
3529  
3534  
3539  
3544  
3549  
3554  
3559  
3564  
3569  
3574  
3579  
3584  
3589  
3594  
3599  
3604  
3609  
3614  
3619  
3624  
3629  
3634  
3639  
3644  
3649  
3654  
3659  
3664  
3669  
3674  
3679  
3684  
3689  
3694  
3699  
3704  
3709  
3714  
3719  
3724  
3729  
3734  
3739  
3744  
3749  
3754  
3759  
3764  
3769  
3774  
3779  
3784  
3789  
3794  
3799  
3804  
3809  
3814  
3819  
3824  
3829  
3834  
3839  
3844  
3849  
3854  
3859  
3864  
3869  
3874  
3879  
3884  
3889  
3894  
3899  
3904  
3909  
3914  
3919  
3924  
3929  
3934  
3939  
3944  
3949  
3954  
3959  
3964  
3969  
3974  
3979  
3984  
3989  
3994  
3999  
4004  
4009  
4014  
4019  
4024  
4029  
4034  
4039  
4044  
4049  
4054  
4059  
4064  
4069  
4074  
4079  
4084  
4089  
4094  
4099  
4104  
4109  
4114  
4119  
4124  
4129  
4134  
4139  
4144  
4149  
4154  
4159  
4164  
4169  
4174  
4179  
4184  
4189  
4194  
4199  
4204  
4209  
4214  
4219  
4224  
4229  
4234  
4239  
4244  
4249  
4254  
4259  
4264  
4269  
4274  
4279  
4284  
4289  
4294  
4299  
4304  
4309  
4314  
4319  
4324  
4329  
4334  
4339  
4344  
4349  
4354  
4359  
4364  
4369  
4374  
4379  
4384  
4389  
4394  
4399  
4404  
4409  
4414  
4419  
4424  
4429  
4434  
4439  
4444  
4449  
4454  
4459  
4464  
4469  
4474  
4479  
4484  
4489  
4494  
4499  
4504  
4509  
4514  
4519  
4524  
4529  
4534  
4539  
4544  
4549  
4554  
4559  
4564  
4569  
4574  
4579  
4584  
4589  
4594  
4599  
4604  
4609  
4614  
4619  
4624  
4629  
4634  
4639  
4644  
4649  
4654  
4659  
4664  
4669  
4674  
4679  
4684  
4689  
4694  
4699  
4704  
4709  
4714  
4719  
4724  
4729  
4734  
4739  
4744  
4749  
4754  
4759  
4764  
4769  
4774  
4779  
4784  
4789  
4794  
4799  
4804  
4809  
4814  
4819  
4824  
4829  
4834  
4839  
4844  
4849  
4854  
4859  
4864  
4869  
4874  
4879  
4884  
4889  
4894  
4899  
4904  
4909  
4914  
4919  
4924  
4929  
4934  
4939  
4944  
4949  
4954  
4959  
4964  
4969  
4974  
4979  
4984  
4989  
4994  
4999  
5004  
5009  
5014  
5019  
5024  
5029  
5034  
5039  
5044  
5049  
5054  
5059  
5064  
5069  
5074  
5079  
5084  
5089  
5094  
5099  
5104  
5109  
5114  
5119  
5124  
5129  
5134  
5139  
5144  
5149  
5154  
5159  
5164  
5169  
5174  
5179  
5184  
5189  
5194  
5199  
5204  
5209  
5214  
5219  
5224  
5229  
5234  
5239  
5244  
5249  
5254  
5259  
5264  
5269  
5274  
5279  
5284  
5289  
5294  
5299  
5304  
5309  
5314  
5319  
5324  
5329  
5334  
5339  
5344  
5349  
5354  
5359  
5364  
5369  
5374  
5379  
5384  
5389  
5394  
5399  
5404  
5409  
5414  
5419  
5424  
5429  
5434  
5439  
5444  
5449  
5454  
5459  
5464  
5469  
5474  
5479  
5484  
5489  
5494  
5499  
5504  
5509  
5514  
5519  
5524  
5529  
5534  
5539  
5544  
5549  
5554  
5559  
5564  
5569  
5574  
5579  
5584  
5589  
5594  
5599  
5604  
5609  
5614  
5619  
5624  
5629  
5634  
5639  
5644  
5649  
5654  
5659  
5664  
5669  
5674  
5679  
5684  
5689  
5694  
5699  
5704  
5709  
5714  
5719  
5724  
5729  
5734  
5739  
5744  
5749  
5754  
5759  
5764  
5769  
5774  
5779  
5784  
5789  
5794  
5799  
5804  
5809  
5814  
5819  
5824  
5829  
5834  
5839  
5844  
5849  
5854  
5859  
5864  
5869  
5874  
5879  
5884  
5889  
5894  
5899  
5904  
5909  
5914  
5919  
5924  
5929  
5934  
5939  
5944  
5949  
5954  
5959  
5964  
5969  
5974  
5979  
5984  
5989  
5994  
5999  
6004  
6009  
6014  
6019  
6024  
6029  
6034  
6039  
6044  
6049  
6054  
6059  
6064  
6069  
6074  
6079  
6084  
6089  
6094  
6099  
6104  
6109  
6114  
6119  
6124  
6129  
6134  
6139  
6144  
6149  
6154  
6159  
6164  
6169  
6174  
6179  
6184  
6189  
6194  
6199  
6204  
6209  
6214  
6219  
6224  
6229  
6234  
6239  
6244  
6249  
6254  
6259  
6264  
6269  
6274  
6279  
6284  
6289  
6294  
6299  
6304  
6309  
6314  
6319  
6324  
6329  
6334  
6339  
6344  
6349  
6354  
6359  
6364  
6369  
6374  
6379  
6384  
6389  
6394  
6399  
6404  
6409  
6414  
6419  
6424  
6429  
6434  
6439  
6444  
6449  
6454  
6459  
6464  
6469  
6474  
6479  
6484  
6489  
6494  
6499  
6504  
6509  
6514  
6519  
6524  
6529  
6534  
6539  
6544  
6549  
6554  
6559  
6564  
6569  
6574  
6579  
6584  
6589  
6594  
6599  
6604  
6609  
6614  
6619  
6624  
6629  
6634  
6639  
6644  
6649  
6654  
6659  
6664  
6669  
6674  
6679  
6684  
6689  
6694  
6699  
6704  
6709  
6714  
6719  
6724  
6729  
6734  
6739  
6744  
6749  
6754  
6759  
6764  
6769  
6774  
6779  
6784  
6789  
6794  
6799  
6804  
6809  
6814  
6819  
6824  
6829  
6834  
6839  
6844  
6849  
6854  
6859  
6864  
6869  
6874  
6879  
6884  
6889  
6894  
6899  
6904  
6909  
6914  
6919  
6924  
6929  
6934  
6939  
6944  
6949  
6954  
6959  
6964  
6969  
6974  
6979  
6984  
6989  
6994  
6999  
7004  
7009  
7014  
7019  
7024  
7029  
7034  
7039  
7044  
7049  
7054  
7059  
7064  
7069  
7074  
7079  
7084  
7089  
7094  
7099  
7104  
7109  
7114  
7119  
7124  
7129  
7134  
7139  
7144  
7149  
7154  
7159  
7164  
7169  
7174  
7179  
7184  
7189  
7194  
7199  
7204  
7209  
7214  
7219  
7224  
7229  
7234  
7239  
7244  
7249  
7254  
7259  
7264  
7269  
7274  
7279  
7284  
7289  
7294  
7299  
7304  
7309  
7314  
7319  
7324  
7329  
7334  
7339  
7344  
7349  
7354  
7359  
7364  
7369  
7374  
7379  
7384  
7389  
7394  
7399  
7404  
7409  
7414  
7419  
7424  
7429  
7434  
7439  
7444  
7449  
7454  
7459  
7464  
7469  
7474  
7479  
7484  
7489  
7494  
7499  
7504  
7509  
7514  
7519  
7524  
7529  
7534  
7539  
7544  
7549  
7554  
7559  
7564  
7569  
7574  
7579  
7584  
7589  
7594  
7599  
7604  
7609  
7614  
7619  
7624  
7629  
7634  
7639  
7644  
7649  
7654  
7659  
7664  
7669  
7674  
7679  
7684  
7689  
7694  
7699  
7704  
7709  
7714  
7719  
7724  
7729  
7734  
7739  
7744  
7749  
7754  
7759  
7764  
7769  
7774  
7779  
7784  
7789  
7794  
7799  
7804  
7809  
7814  
7819  
7824  
7829  
7834  
7839  
7844  
7849  
7854  
7859  
7864  
7869  
7874  
7879  
7884  
7889  
7894  
7899  
7904  
7909  
7914  
7919  
7924  
7929  
7934  
7939  
7944  
7949  
7954  
7959  
7964  
7969  
7974  
7979  
7984  
7989  
7994  
7999  
8004  
8009  
8014  
8019  
8024  
8029  
8034  
8039  
8044  
8049  
8054  
8059  
8064  
8069  
8074  
8079  
8084  
8089  
8094  
8099  
8104  
8109  
8114  
8119  
8124  
8129  
8134  
8139  
8144  
8149  
8154  
8159  
8164  
8169  
8174  
8179  
8184  
8189  
8194  
8199  
8204  
8209  
8214  
8219  
8224  
8229  
8234  
8239  
8244  
8249  
8254  
8259  
8264  
8269  
8274  
8279  
8284  
8289  
8294  
8299  
8304  
8309  
8314  
8319  
8324  
8329  
8334  
8339  
8344  
8349  
8354  
8359  
8364  
8369  
8374  
8379  
8384  
8389  
8394  
8399  
8404  
8409  
8414  
8419  
8424  
8429  
8434  
8439  
8444  
8449  
8454  
8459  
8464  
8469  
8474  
8479  
8484  
8489  
8494  
8499  
8504  
8509  
8514  
8519  
8524  
8529  
8534  
8539  
8544  
8549  
8554  
8559  
8564  
8569  
8574  
8579  
8584  
8589  
8594  
8599  
8604  
8609  
8614  
8619  
8624  
8629  
8634  
8639  
8644  
8649  
8654  
8659  
8664  
8669  
8674  
8679  
8684  
8689  
8694  
8699  
8704  
8709  
8714  
8719  
8724  
8729  
8734  
8739  
8744  
8749  
8754  
8759  
8764  
8769  
8774  
8779  
8784  
8789  
8794  
8799  
8804  
8809  
8814  
8819  
8824  
8829  
8834  
8839  
8844  
8849  
8854  
8859  
8864  
8869  
8874  
8879  
8884  
8889  
8894  
8899  
8904  
8909  
8914  
8919  
8924  
8929  
8934  
8939  
8944  
8949  
8954  
8959  
8964  
8969  
8974  
8979  
8984  
8989  
8994  
8999  
9004  
9009  
9014  
9019  
9024  
9029  
9034  
9039  
9044  
9049  
9054  
9059  
9064  
9069  
9074  
9079  
9084  
9089  
9094  
9099  
9104  
9109  
9114  
9119  
9124  
9129  
9134  
9139  
9144  
9149  
9154  
9159  
9164  
9169  
9174  
9179  
9184  
9189  
9194  
9199  
9204  
9209  
9214  
9219  
9224  
9229  
9234  
9239

mobile terminals over an unlicensed radio interface and a fixed broadband network connecting said access control part and said at least one base station part, wherein said access network portion is arranged to relay upper layer messages between a mobile terminal and said core network portion in a transparent manner over said unlicensed radio interface. Preferably the upper layer messages include mobility management messages and above. Preferably still the unlicensed radio interface uses broadband radio. Advantageously the unlicensed radio interface is a Bluetooth interface.

(2) An access network adapted to communicate with mobile terminals over an unlicensed radio interface and with a core network portion over a predetermined mobile network interface, wherein at least upper layer messages exchanged between said mobile terminal and said core network are relayed substantially transparently over said unlicensed radio interface and through said access network. Preferably the unlicensed radio interface uses broadband radio. Preferably still the unlicensed radio interface is a Bluetooth interface.

(3) A base station for use as part of an access network arranged to communicate with a core network portion of a public mobile telecommunications network, wherein the base station is adapted to communicate over an unlicensed radio interface with at least one mobile terminal and to communicate through a fixed broadband network with an access control part of said access network connected to said core network, wherein said base station is arranged to relay messages transmitted between said mobile terminal and said core network transparently over said unlicensed radio interface and through said fixed network. Preferably the base station includes a first interface module for relaying upper layer messages over said unlicensed radio link and a second interface module for relaying said upper layer messages over said fixed network, said first and second interface modules being arranged to transfer upper layer messages between one another substantially transparently. Preferably still said second interface module is arranged to relay upper layer messages over an IP-based fixed network.

(4) An access network controller for use as part of an access network arranged to enable communication of a mobile terminal with a public mobile telecommunications network through an unlicensed radio interface, wherein the access network controller is arranged to communicate with a core network portion of said public mobile telecommunications network over a predetermined licensed mobile network interface and is further connected to a fixed broadband network for communication with mobile terminals through at least one base station, wherein said access network controller is arranged to transmit and receive upper layer messages exchanged

with mobile terminals in a transparent manner over said fixed broadband network. Preferably the access network controller includes an interface module for relaying upper layer messages over said fixed network. Preferably still said fixed broadband network is an IP-based network, wherein said interface module is arranged to relay upper layer messages through an IP protocol tunnel. Advantageously said fixed broadband network is an ATM-based network. Preferably the access network controller includes a register for mapping the location of mobile terminals to a base station, wherein said register is arranged to be accessible on receipt of a paging request from said core network to a mobile terminal to determine a base station able to communicate with said mobile terminal.

(5) A mobile telecommunications network including an access network portion and a core network portion, wherein the access portion includes a plurality of base station systems for communicating with mobile terminals over a licensed public mobile network air interface, the base station systems being arranged to communicate with said core network portion over a predetermined mobile network interface, wherein said network includes at least one local base station system arranged to communicate with said core network portion over said predetermined mobile network interface and further adapted to communicate with mobile terminals over an unlicensed radio interface, wherein said local base station system is arranged to relay upper layer messages between said mobile terminals and said core network substantially transparently. Preferably said local base station system includes at least one local base station for communicating with mobile terminals over said unlicensed radio interface and a local base station controller connected to said at least one local base station and adapted to communicate with said core network portion over said predetermined network interface. Preferably still the local base station is connected to the local base station controller through a fixed broadband network. Advantageously the fixed network is an IP-based network, and upper layer messages exchanged between said mobile terminals and said core network portion are relayed between said local base station and said local base station controller by tunnelling through said IP-based network. Preferably the fixed network is an ATM-based network. Preferably the unlicensed radio interface uses broadband radio. Preferably still the unlicensed radio interface is a Bluetooth interface.

(6) A mobile terminal for communicating with a mobile telecommunications network including an access network portion and a core network portion, said terminal including a communication management module for generating upper layer messages for, and receiving upper layer messages from, said

core network, a first interface module for establishing a licensed public mobile network radio link with said access network portion and relaying said upper layer messages to and from said communication management module, wherein the terminal further includes a second interface module for establishing an unlicensed radio link with a modified access network connected to said core network, wherein said second interface module is arranged to relay said upper layer messages over said unlicensed radio link when said mobile terminal is connected to said modified access network. Preferably its second interface module is arranged to relay said upper layer messages between said communication management module and said core network portion over said unlicensed radio link in a transparent manner. Preferably still the unlicensed radio interface uses broadband radio. Advantageously the unlicensed radio interface is a Bluetooth interface.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Further objects and advantages of the present invention will become apparent from the following description of the preferred embodiments that are given by way of example with reference to the accompanying drawings. In the figures:

- Fig. 1 schematically depicts parts of a modified GSM network,
- Fig. 2 depicts the signalling sequence for automatic configuration of a fixed access network portion in accordance with the present invention,
- Fig. 3 schematically depicts an overview of the organisation within a mobile terminal,
- Fig. 4 schematically depicts the functional organisation of the mobile terminal,
- Fig. 5 schematically depicts the functional organisation of a home base station and home base station controller,
- Fig. 6 schematically depicts the organisation of cells,
- Fig. 7 schematically illustrates a subscriber location register of the home base station controller,
- Fig. 8 depicts the signalling sequence for handover,
- Fig. 9 shows the protocol stacks of the modified access network in the control plane,
- Fig. 10 shows the protocol stacks of the modified access network in the user plane.

#### DETAILED DESCRIPTION OF THE DRAWINGS

[0011] The network illustrated schematically in Fig. 1 includes standard elements of the GSM architecture and also includes elements of a General Packet Radio Service (GPRS) network. A mobile phone or terminal MT 1 is illustrated in Fig. 1. This communicates with the GSM network. The network comprises a access network portion (AN) 10 and a core network portion (CN) 20. The divisions between these portions are denoted by dotted lines in Fig. 1. As the names suggest, the access network portion 10 provides the mobile terminal 1 with access to the core network 20, and through this to other network services.

[0012] In the exemplary network illustrated in Fig. 1 the core network portion 20 includes a home location register (HLR) 201 and mobile services switching centres (MSC) 202. The network also supports the General Packet Radio Service, and to this end includes serving GPRS support nodes (SGSN) 203. The function and structure of these elements are well known and will not be described in detail here. Moreover, it will be understood that other elements will be present in a GSM core network although they are not illustrated in Fig. 1. The core network portion 20 may provide access to other, external networks 30, such as ISDN and PSTN networks and packet and circuit switched packet data networks such as intranets, extranets and the Internet through one or more gateway mobile service switching centres GMSCs 204 and gateway GPRS support nodes GGSNs 205.

[0013] The access network portion 10 includes the typical GSM elements, specifically base station subsystems BSS 101, one of which is illustrated schematically in Fig. 1. The base station subsystems 101 are connected through the defined fixed standard A and Gb interfaces with MSCs 202 and SGNs 203, respectively in the core network portion 20. Each base station subsystem 101 includes a base station controller BSC 102 which communicates with one or more base transceiver stations BTS 103 via the defined A<sub>bus</sub> air interface. The base transceiver stations 103 communicate with mobile terminal MT 1 over the GSM standard U<sub>2m</sub> radio air interface. It will be understood that while the BTS 103 and BSC 102 are depicted as forming a single entity in the BSS 101, the BSC is often separate from the BTSs and may even be located at the mobile services switching centre MSC 202. The physical division depicted in Fig. 1 serves to distinguish between the parts of the network making up the access network portion 10 and those that form the core network portion 20.

[0014] In addition to the standard GSM access network portion provided by the BSSs 101, the network according to the invention includes a modified access network portion as shown in the lower half of Fig. 1 and denoted by the numeral 10'. Hereinafter this will be described as a fixed access network portion 10'. The components making up this fixed access network portion 10'

also enable the mobile terminal 1 to access the GSM core network portion, and through this, other communication networks via an unlicensed radio interface X, represented in Fig. 1 by the bi-directional arrow 11. By unlicensed radio is meant any radio protocol that does not require the operator running the mobile network to have obtained a license from the appropriate regulatory body. In general, such unlicensed radio technologies must be low power and thus of limited range compared to licensed mobile radio services. This means that the battery lifetime of mobile terminals will be greater. Moreover, because the range is low the unlicensed radio may be a broadband radio, thus providing improved voice quality. The radio interface may utilise any suitable unlicensed radio protocol, for example a wireless LAN protocol or Digital Enhanced Cordless Telecommunications (DECT). Preferably, however, Bluetooth radio is utilised, which has a high bandwidth and lower power consumption than conventional public mobile network radio.

[0015] The Bluetooth standard specifies a two-way digital radio link for short-range connections between different devices. Devices are equipped with a transceiver that transmits and receives in a frequency band around 2.45GHz. This band is available globally with some variation of bandwidth depending on the country. In addition to data, up to three voice channels are available. Each device has a unique 48-bit address from the IEEE 802 standard. Built-in encryption and verification is also available.

[0016] The element of the fixed access network portion 10' adapted to communicate across the Bluetooth interface is designated a local or home base station (HBS) 104. This element handles the radio link protocols with the mobile terminal MT 1 and contains radio transceivers that define a cell in a similar manner to the operation of a conventional GSM base station transceiver BTS 103. The home base station HBS 104 is controlled by a home base station controller HBSC 105, which communicates with a mobile service switching centre MSC 202 over the GSM standard A interface and also with a serving GPRS support node SGSN 203 over a standard Gs interface, if available in the core network portion. The interface between the home base station HBS 104 and its home base station controller HBSC 105 is designated a Y-interface. The home base station controller HBSC 105 provides the connection between the MSC 202 or SGSN 203 and mobile terminal 1. The joint function of the home base station HBS 104 and the home base station controller HBSC 105 emulate the operation of the BSS 101 towards the SGSN 203 and MSC 202. In other words, when viewed from the elements of the core network 20 such as the mobile service switching centre (MSC) 202 and the serving GPRS support node (SGSN) 203, the fixed access network portion 10' constituted by the home base station HBS 104 and the home base station controller HBSC 105 looks like a conventional access network portion 10.

[0017] The applications that run on the mobile terminal 1 on top of the public mobile network radio interfaces also run on top of Bluetooth radio between the mobile terminal 1 and the home base station HBS 104.

[0018] The interface between the home base station HBS 104 and the home base station controller HBSC 105 which is designated Y in Fig. 1 is preferably provided by a fixed link. The home base station 104 is intended to be a small device that a subscriber can purchase and install in a desired location such as the home or an office

environment to obtain a fixed access to the mobile network. In order to reduce the installation costs on the part of the operator, the interface between the home base station 104 and the home base station controller 105, which is designated interface Y in Fig. 1 therefore preferably exploits an already existing connection provided by a fixed network 106. Preferably this network is a broadband packet network. Suitable networks might include those based on ADSL, Ethernet, LMDS, or the like. Home connections to such networks are increasingly available to subscribers. Although not shown in Fig. 1, the home base station HBS 104 will be connected to a network terminal giving access to the fixed network 106, while the home base station controller HBSC 105 may be connected to an edge router ER of the network 106 that also links the fixed network 106 to other networks such as intranets and the internet. IP is used for communication between the home base station HBS 104 and home base station controller HBSC 105 over the fixed network 106 to render the transport of data independent of the network type. The link between the home base station HBS 104 and the home base station controller HBSC 105 is preferably always open, so that this connection is always available without the need for reserving a channel. Communication across this fixed network 106 is performed by tunnelling, in other words the upper protocol layers are transported across the access network 106 in a transparent way, without mapping or interworking, as will be described in more detail below. In parallel with the home base station HBS 104, the user may have other devices connected to the fixed network, such as a PC. While the fixed network 106 is preferably an IP-based network, the invention is not limited to this type of network. Specifically ATM-based networks could also be used. In particular when DSL technologies are used in this network, they could be used directly on top of the ATM layer, since they are based on ATM. Naturally, an ATM based network could also be used to transport IP, serving as a base layer.

[0019] The home base station HBS 104 is a device that can be purchased by a subscriber and installed by the subscriber in the desired location by plugging it in to a port of an ADSL or CATV modem to access the fixed network 106. The port is in contact with an intranet that is either bridged or routed on the IP level. Thus standard protocols, such as IP, DHCP, DNS and the like are used. The home base station HBS 104 connected to the modem utilises these standard protocols and functions to ascertain to which home base station controller HBSC

105 it should connect, and also to establish a connection with this home base station controller HBSC 105.

[0020] Each home base station controller HBSC 105 controls several home base stations HBS 104 and to this end holds a data structure representing a logical view of these home base stations HBS 105. Configuration procedures alter this data structure as home base stations HBS 104 are added or removed. This will be described in further detail below. When a home base station HBS 104 is added, the home base station controller HBSC 105 establishes a TCP or SCTP connection with the home base station HBS 104. Before this connection has been established the home base station HBS 104 is unable to transfer messages to the home base station controller HBSC 105 even in response to a broadcast paging message. A home base station HBS 104 is allocated an IP address on the fixed network 106. This IP address may either be configured manually prior to installation or be obtained using a DHCP request. The home base station controller HBSC 105 will naturally also have an IP address on the fixed network 106. This address will also be known by the home base station HBS 104 either by manual configuration or obtained by a DNS query to the fixed network 106, in which case the HBS 104 is configured with the symbolic name of the home base station controller HBSC.

[0021] The signalling sequence for this configuration procedure is illustrated in Fig. 2. Specifically, Fig. 2 illustrates the signalling between a home base station HBS 104, an attach-query-port of a home base station controller HBSC 105 and an ADM port of the home base station controller HBSC 105. The procedure starts at power-up or reset, when the home base station HBS 104 attempts to attach to an attach-query-port in the home base station controller HBSC 105. This is achieved first by the home base station HBS 104 sending a TCP synchronisation signal at event 1, which is repeated and acknowledged by the port at event 2. The home base station HBS 104 then sends an ATTACHMENT\_QUERY message in event 3. This message contains the Bluetooth device address of the HBS. If the HBS has previously been connected to the HBSC 105, this message will also contain a location area identifier LAI of the HBS 104 and an Id of the HBS 104. These identifiers will be discussed in more detail below with respect to roaming. Security related information is preferably also included in this message to enable the HBSC 105 to authenticate the home base station HBS 104. The home base station 104 is a device that will be acquired by a subscriber and will possibly not be supplied by the operator of the home base station controller 105. It is therefore important to verify that the home base station 104 is authorised to connect to the home base station controller 105 in the same way as a mobile terminal is conventionally authenticated before being allowed to connect to a public mobile communications network. The home base station controller HBSC 105 also has access to a database containing relevant Bluetooth de-

vice address information for checking. On reception of the ATTACHMENT\_QUERY message, the HBSC 105 stores the IP address of the HBS 104 and the Bluetooth device address, selects an Ethernet interface that should be used by the HBS 104 and two ports that the HBS 104 should use for static and dynamic TCP connections, respectively. The HBSC 105 then opens the assigned ADM and traffic ports for listening. Only the designated home base station HBS 104 will be authorised to connect to these ports, based on its IP address. The assigned ports and other information including the IP address of the selected interface, the location area identifier LAI and a unique identifier HBS Id, is communicated to the HBS in event 5 with an ATTACHMENT\_RESPONSE message. On reception of this message, the HBS 104 stores the LAI and HBS Id in non-volatile memory, so that this information will be available after a reset. The TCP connection with the HBSC 105 attach-query-port is then closed by the exchange of messages in events 6 to 8. The home base station HBS 104 then has a limited time, for example 2 minutes, in which to attempt a static TCP connection, otherwise the ports will be closed and allocated resources in the HBSC 105 released. This occurs in events 9 to 11 with TCP synchronisation messages, followed in event 12 by a message from the HBSC 105 communicating system information relevant to the HBS 104. In order to test the static TCP connection, the HBS 104 must send a message to the static port of the HBSC 105, as shown in event 13, in the form of a HBS\_ALIVE message. If this message is not received at predetermined intervals the HBSC will close the ports and release the allocated resources. The required time interval is preferably communicated to the home base station HBS 104 by the home base station controller 105 with the ATTACHMENT\_RESPONSE message in event 5. A dynamic TCP connection is set up with the traffic port of the HBSC.

[0022] The services provided to the subscriber are independent of whether the mobile terminal MT 1 establishes a link through fixed access network portion 10' or through a standard access network 10, such as represented by a base station sub-system BSS 101 in a GSM network. This is achieved by using the same service environment for all applications. This means, for example, that circuit-switched voice services are executed in the mobile services switching centre MSC 202. If WAP based services are supported these will be executed in WAP servers as in the conventional network. This also means that the user subscription is located in the home location register HLR 201, even though the user has a subscription to a fixed access network portion 10' in the form of the home base station HBS 104.

[0023] A simplified block diagram of the structure of the mobile terminal 1 is shown in Fig. 3. This mobile terminal 1 includes the standard upperlayer functions 301 required for any mobile operating in a GSM system. These specifically include the connection management

layer and mobility management layer. These layers 301 handle the telephony and, if present, packet data transmission and wireless access protocol (WAP) functions. These upper layer functions 301 connect with the GSM radio function module 302 as in a conventional GSM mobile terminal. The GSM radio module 302 may also support GPRS functions. In addition to this GSM radio module 302, the mobile terminal additionally includes a further radio module 303 for the unlicensed radio service. In the preferred embodiment, the radio service is Bluetooth. This Bluetooth radio function module 303 communicates directly with the upper layer functions 301. The upper layer functions 301 thus transmit the same messages to the mobile core network portion whether using the GSM radio function module 302 or the Bluetooth radio function module 303. This allows the subscriber to perceive no change in the service obtainable whether the mobile terminal is in the coverage area of a home base station (HBS) 104 or a base station subsystem 101.

[0024] Fig. 4 shows a block representation of the functional organisation of the mobile terminal 1. In common with a conventional GSM terminal, the illustrated mobile terminal 1 includes a connection management layer 310 and a mobility management layer MM 320. In conventional GSM terminals, the mobility management layer MM 320 uses the resources of the radio resource RR layer. In the mobile terminal according to the present invention, a radio resource sub-layer RR 340 dedicated to a GSM radio interface 350 is also included and will be used in the same way as the radio resource layer in a conventional GSM terminal. Incidentally, the GSM radio interface 350 may also serve as a general packet radio interface GPRS. However, functional organisation of the mobile terminal 1 differs from conventional GSM terminals by the inclusion of an unlicensed radio interface, in the exemplary embodiment a Bluetooth radio interface 370 and a radio resource sub-layer 360 dedicated to this Bluetooth radio interface 370. A logical layer 380 for adaptation of the Bluetooth radio interface is provided between the Bluetooth radio interface and the Bluetooth radio resource sub-layer 360. The unlicensed radio interface 370 is run in parallel with the GSM radio interface 350. In order to co-ordinate the two radio resource layers 340, 360, a sub-layer 330 is provided between these and the mobility management MM layer 320. This service co-ordination layer 330 effectively hides the existence of two separate radio resource RR sub-layers from the upper layers. The Bluetooth radio resource layer 360 signals to the service co-ordination layer 330 when it is entering or leaving the coverage of a home base station HBS area. This organisation means that the upper layers 320, 310 of the mobile terminal 1 operate as if only one radio interface is present. This permits the subscriber to pass between links with a conventional base station sub-system 101 or a home base station 104 without noticing a difference in service.

[0025] Fig. 5 shows the functional organisation of the

fixed access network portion 10' that communicates with a mobile terminal MT 1 over an unlicensed radio link. The X-interface 11 shown in Fig. 4 departing from the Bluetooth radio module 370 connects the mobile terminal MT 1 of Fig. 4 with the a base station HBS 104 shown in Fig. 5. The home base station HBS 104 also has a Bluetooth radio module 401 that connects with a Bluetooth radio resources sub-layer BT-RR 403 through a Bluetooth adaptation layer 402. The Bluetooth radio resources sub-layer 403 provides services to upper level layers 404, which are essentially so-called 'layer 3' services, although the radio resource control protocol layers conventionally included in layer 3 in GSM systems are not part of these layer 3 services. As discussed later, the upper layers that are transported transparently, i.e. without interworking or mapping, through the fixed access network 10' include at least the mobility management protocol layer and above. These upper layer services are indicated in the figure by a double-headed arrow 404 between lower layers on the mobile terminal and home base station controller sides of the home base station. The lowest layers at the interface between the home base station HBS 104 and the home base station controller HBSC 105 is adapted to run IP. A suitable interface is the 10 Base T or 100 Base T Ethernet interface. This is illustrated in Fig. 5 by a lower IP layer 406 on top of which either TCP or UDP 405 is run. It will be understood that SCTP may be used in place of TCP. Above this layer is provided a radio resource layer RR IP 407 that is specifically adapted to the IP-based interface between the home base station HBS 104 and the home base station controller HBSC 105. The physical interface between these elements is an IP based fixed network 106. At the home base station controller HBSC 105, the lower layers 501 are again the modified IP adapted radio resource control layer RR IP 503 over TCP (or SCTP) or UDP over IP. In Fig. 5 only a GSM home base station controller HBSC is shown. As for the home base station HBS 104, the lower layers 501 of the home base station controller HBSC 105 provide services to the upper layers 502, which again are represented as an arrow directed towards the core network portion side of the home base station controller 105. It is apparent from this organisation that the upper layers, in other words essentially the layer 3 services represented by the mobility management MM 320 and connection management CM 310 layers in the mobile terminal MT 1 are relayed between the mobile terminal MT and the core network portion 20 without mapping or other interworking functions. The transport of these layers is transparent to the lower Bluetooth layers 360, 380, 370 and 401, 402, 403 of the X interface and to the TCP or UDP over IP layers of the Y interface through the fixed network 106. The connection through the fixed network 106 is thus a tunnel.

[0026] As mentioned above, the installation of the fixed access network portion 10', is simplified by obviating the need for cell planning on the part of the network

operator. A consequence of this is that, unlike a base station controller BSC 102 in a GSM network, the fixed access network 10' will not know the location of a home base station HBS 104 relative to surrounding cells, and so cannot direct a mobile terminal MT 1 to listen out for signals from specific cells in anticipation of handover. This is overcome in accordance with the invention by using a self-planning radio technology and allowing the mobile terminal MT 1 to pass information about neighbouring cells in the public mobile network to the home base station controller HBSC 105 unsolicited by the access network 10'. Preferably, the mobile terminal MT 1 retains identification information of the last public mobile network cell in which it was located. This information is passed to the network in anticipation of possible handover. The mobile terminal MT 1 may also monitor signal strengths of surrounding cells periodically and pass this information together with the cell identification to the network. Consequently, the knowledge about cells neighbouring to the coverage of a home base station HBS 104 is built up dynamically as this information is passed on by the mobile terminal MT 1. The information is preferably passed from the mobile terminal MT 1 to the network using a location update message, which is known from conventional public mobile network procedures such as GSM.

[0027] The organisation and mechanisms required for roaming and handover between the coverage area of home base stations HBS 104 and cells of a public mobile network defined by base transceiver stations 103 is described further below.

#### Roaming

[0028] In conventional public mobile systems, such as GSM, network coverage is divided into multiple location areas LA, which may comprise one or several BTS cells. Each location area is assigned a unique code called a location area identifier LAI. A similar system of areas, termed routing areas RA is proposed in the general packet radio service GPRS. The position of a mobile terminal MT 1 can be tracked using the system of location areas LA when no session is ongoing. Specifically, when a mobile terminal MT 1 enters a new LA it reports this to the network. This information is used by the network when the mobile terminal MT 1 is paged. The network pages the whole location area LA and waits for the paged terminal to respond.

[0029] In accordance with the present invention, all home base stations HBS 104 configured to connect to a single home base station controller HBSC 105 are assigned to the same location area LA. This is illustrated in Fig. 6. Fig. 6 shows four cells 40 of a conventional GSM mobile network each represented as a hexagon. Each cell 40 is defined by, and surrounds, a base transceiver station BTS 103. In the illustrated example, two cells are grouped into a single location area 41. This is shown as a continuous line around the two cells 40.

Within this location area 41 is a second, Bluetooth location area 42 containing a home base station HBS 104. A further home base station HBS 104 and its surrounding coverage area that is also designated the location area 42 is located partly in this location area 41 and partly in a neighbouring cell 40.

- [0030] When a mobile terminal MT 1 moves into the location area 42 of the home base station HBS 104, the Bluetooth module 303 in the mobile terminal MT 1 and a Bluetooth module in the home base station establish a Bluetooth communication link. On a functional level, the Bluetooth radio resource sub-layer 306 in the mobile terminal 1 determines whether the signal strength is good enough to establish a reliable connection. The Bluetooth radio resource sub-layer 306 then informs the mobility management MM functional plane 320 via the service co-ordination sub-layer 330 about the new location area 42, which triggers the mobility management layer 320 to perform a location update procedure directed towards the home base station HBS 104 in the location area 42. The Bluetooth radio resource sub-layer 306 periodically reads the signal strength and informs the service co-ordination sub-layer 330 about the current level.
- [0031] When the mobile terminal MT 1 moves out of the home base station 104 coverage area 42 such that the signal level drops to a critical level, the service co-ordination sub-layer 330 activates the GSM radio interface 350 through the radio resource sub-layer 340.
- [0032] When the mobility management MM layer 320 is informed about the new location area 41, which is assigned to the public mobile network, a location update procedure will be performed using normal GSM procedures.
- [0033] As mentioned above, in conventional public mobile telecommunication networks location areas LA normally cover a number of cells. In the fixed access network portion 10' of the invention, a single home base station controller HBSC 105 will handle one location area. In other words all home base stations HBS 104 connected to a home base station controller HBSC 105 will be assigned to a single location area. Since the network operator has no influence over the true location of a home base station HBS 104 as this may be installed at any suitable location by a subscriber conventional cell planning and organising of home base stations into location areas is not practical.
- [0034] A consequence of providing only a single location area LA for all mobile terminals is that a paging message transmitted by the core network 20 will naturally be addressed to all mobile terminals. Allowing all terminals to be paged in this way is naturally a waste of network resources. To prevent this, the home base station controller HBSC 105 is provided with a register or database 1051 for storing the location of mobile terminals that have been connected to home base stations 104. This is illustrated schematically in Fig. 7. This register 1051 is similar in structure to a visitor location register

VLR. It may be constructed as part of the home base station controller structure, or be a separate entity that can be accessed and consulted by the home base station controller as necessary. The register 1051 is constructed as information is received about the location of a mobile terminal. The coverage of a single home base station HBS 104 will define a cell and each home base station HBS will have a unique cell identity. As mobile terminals 1 roam into a cell of a home base station and performs a location update, the home base station controller HBSC maps the international mobile subscriber identity IMSI of the mobile terminal to a home base station cell identity HBS\_Id. This register will thus be modified as a new mobile terminal roams into a new home base station HBS cell.

[0034] When a mobile is paged, the home base station controller HBS 105 looks into the paging message to determine which mobile terminal is paged by identifying the IMSI. Using the mapping in the register 1051, the home base station controller determines to which home base station 104 the paging message should be sent and can thus confine the paging message to this home base station 104 only. The cell identification associated with each home base station HBS ensures that this is transparent for existing charging and statistical functions in mobile services switching centres MSC 202 and serving GPRS support nodes SGSN 203.

[0035] Preferably it is possible to limit access to the core network 20 through the fixed access network portion 10', so that a subscriber can specify which mobile terminals will be able to recognise a Bluetooth radio connection with a particular home base station HBS. This can be achieved with Bluetooth radio by using the feature within Bluetooth to pair entities. For a home base station HBS 104 required to provide access to multiple mobile terminals 1, such as in a corporate environment, user selection is preferably performed on a network level.

#### Handover

[0036] Since home base stations and their associated cells will generally be located in the coverage area of base transceiver stations BTS 103 of a public mobile network, handover of an established call from a base transceiver station BTS 103 to a home base station will not be necessary. Thus all calls established via GSM or other public mobile network radio will be concluded on public mobile network radio. If the mobile terminal has roamed into a home base station cell during this session and remains in this cell, subsequent calls will be performed using the Bluetooth radio or other unlicensed radio interface.

[0037] Handover is thus necessary only when a call established through a home base station HBS 104 using Bluetooth radio must be passed over to a base station transceiver BTS 103 using public mobile network radio when the mobile terminal moves out of the coverage ar-

ea of the home base station HBS 104. This procedure is illustrated in Fig. 8.

[0038] Fig. 8 shows the sequence of signalling between the mobile terminal MT 1, the home base station 5 HBS 104, the home base station controller HBSC 105, the mobile services switching centre MSC 202 and a base transceiver station BTS 103 and base station controller of a base station sub-system BSS 101.

[0039] Before handover is performed it is assumed 10 that the mobile terminal MT 1 has previously identified the strongest public mobile radio signal from a neighbouring cell 40, or alternatively retains the cell id of the last public mobile radio cell used, and subsequently passed the cell identity to the home base station controller HBSC 105 via the home base station HBS 104 as part of the location update procedure.

[0040] As already described in relation to roaming, the Bluetooth radio resource sub-layer 360 periodically monitors the Bluetooth signal strength and reports this 20 to the service co-ordination sub-layer 330. When a call is active, the Bluetooth radio resource sub-layer 360 also sends a message for delivery to the home base station HBS 104, which is conveyed to the home base station controller HBSC 105. This is illustrated at events 1 and 2 in Fig. 8. The home base station controller HBSC 105 evaluates the reported measurements to determine whether handover is required. If handover is required, a HANDOVER REQUIRED message is generated with the cell identity of the GSM cell previously delivered written into this message. This message is sent to the mobile services switching centre MSC 202 as shown at event 3. The MSC 202 then sends a HANDOVER request to a base station controller BSC 102 of the identified base transceiver station 103 in event 4. The base station controller takes care of allocating a traffic channel in accordance with conventional GSM procedures and receives an acknowledgement of the activation of this channel from the base transceiver station in events 5 and 6. In event 7 the base station controller BSC 102 sends an acknowledgement of the HANDOVER request to the MSC 202, which in turn sends a HANDOVER command to the home base station controller HBSC 105 in event 8 for transmission to the home base station HBS 104 in event 9. The home base station HBS 104 sends a HANDOVER command to the mobile terminal MT 1 in event 10. This is received by the Bluetooth radio resource sub-layer 360 and passed via the service co-ordination sub-layer 330 to the radio resource sub-layer 340 above the GSM radio module 350, which then starts 30 to send handover access bursts over the Uu interface to the base transceiver station BTS 103 in event 11. These are detected in the normal way by the base transceiver station BTS 103, which reports detection to the MSC 202 via the base station controller BSC 102 in events 12 and 13. The link is then established between the base station transceiver BTS 103 and the mobile terminal MT 1 and after the base station transceiver BTS 103 has sent an establish indication message to the

base station controller BSC 202, the handover is completed and an acknowledgement sent by the base transceiver station BTS 103 to the base station controller BSC 202 and by the base station controller BSC to the MSC 202 in events 15 and 16. The MSC 202 then switches to the new path.

[0041] Before handover takes place, the subscriber is preferably alerted that the mobile terminal is moving out of range of the home base station HBS 104, i.e. that the Bluetooth radio signal is reaching a critically low level. This may be done by the service co-ordination sub-layer 330 ordering an audio or other alarm notification while a signal level is at a critical level and terminating this notification when the signal level rises.

[0042] Figs. 9 and 10 show protocol architectures for the various elements in the fixed access network portion 10' of a second generation GSM access network according to the invention.

[0043] Fig. 9 illustrates the protocol layers for transport of third generation protocol specified in the 3GPP Technical Specification 24.008 between a mobile terminal MT 1 and a mobile services switching centre MSC 202. In the control plane, the peer higher level layers of the mobile terminal MT 1 and the mobile services switching centre MSC 202 communicate directly with one another. In other words these layers are relayed through lower layers by both the home base station HBS 104 and the home base station controller HBSC 105 in a transparent manner. These levels are the mobility management MM layer and the CC, GMM, SM and short message service layers. The lower layers of the mobile terminal MT 1 communicate directly with peer layers in the home base station HBS 104. These include the Bluetooth radio resource control protocol layer RR BT, which among other tasks deals with the allocation of synchronous Bluetooth channels. Below the Bluetooth radio resource control protocol is the layer 2 competitive access provider L2CAP and the Bluetooth baseband layer. At the Y interface between the home base station HBS 104 and home base station controller HBSC 105 is provided a further radio resource control protocol adapted to IP layer RR IP. Below this radio resource layer is include an IETF synchronous control transport protocol SCTP, which with communicates with a peer SCTP layer in the HBSC 105. It will be apparent that this SCTP layer could be replaced by a TCP protocol layer. This is carried on an IP layer, which likewise communicates with an IP layer in the HBSC 105. Finally lower layer tunnels through the fixed network 106 establish direct links with corresponding layers in the HBSC 105. The upper layer protocol messages are carried through the home base station HBS 104, the home base station controller HBSC 105 and across the Y interface over the respective radio resource control protocol layers. Turning now to the A-interface between the HBSC 105 and MSC 202, the upper layer messages are carried over a base station service access point layer BSSAP. This sits above a signalling connection control part layer SCCP,

a message transfer part layer MTP and a layer 1 level, in that order. Each of these layers communicate with peer layers in the MSC 202.

[0044] The provision of a radio resource layer BT-RR

5 /RR IP in the mobile terminal 1, home base station and home base station controller that is suitably adapted to carry upper layer messages over Bluetooth and IP based links, respectively enables 24.008 messages to be carried from the mobile terminal through to the mobile services switching centre MSC 202, and therefore over both an unlicensed radio interface and an IP-based fixed network in a transparent manner. Thus all services in 10 24.008 can be supported for a mobile terminal MT that accesses the mobile core network portion via an unlicensed radio link, such as Bluetooth, in a forward compatible manner.

[0045] The modified Bluetooth and Internet Protocol radio resource control protocols RR BT and RR IP differ from the GSM standard protocol. Specifically, these new 20 protocols are dependent on, and adapted to, the unlicensed radio technology used and transport over IP, respectively. They provide a transparent transport mechanism for upper layer information that is of the mobility management layer and above. They also support the 25 existing service access points (SAP) to the mobility management layer. In addition to these new radio resource protocols a modified mobility management protocol is used for 24.008 transport. Specifically, the mobility management layer enables cell planning, i.e. enabling 30 the network entity that controls a number of cells to obtain the identity and other data of neighbouring cells that it does not control. The layer 2 protocol in the mobile terminal MT must also support the interaction between the radio resource layer for GSM radio and the radio resource layer for Bluetooth radio.

[0046] Fig. 10 depicts the user control plane for voice 35 transport between a mobile terminal MT 1 and a mobile services switching centre MSC 202. At the top of the layers in the mobile terminal MT 1 G.711 voice protocol 40 communicates directly with a peer layer at a called or calling subscriber. These protocol messages are relayed through the home base station HBS 104, home base station controller HBSC 105 and the mobile services switching centre MSC 202. The next layer down in 45 the mobile terminal MT 1 defines the modulation scheme, which is continuously variable slope delta modulation CVSD. This layer sits above a Bluetooth baseband layer, which is the lowest layer in the MT. This lowest layer communicates with a peer layer in the HBS, which likewise lies below a modulation layer CVSD. On 50 the Y-interface between the HBS 104 and HBSC 105 an RTP layer sits at the top of the stack above a UDP over IP layer, which communicates directly with a peer layer in the HBSC 105. Below the UDP over IP layer are tunnelling layers for establishing direct tunnelling links across the fixed network 106 as in the control plane described with reference to Fig. 9. The A interface between the HBSC 105 and MSC 202 uses the standard E1 pro-

tocol.

[0047] While the present invention has been discussed with reference to a GSM network, it will be understood that it may be applied to other mobile networks, specifically the third generation mobile network UMTS both with or without GPRS. The invention as described above may be used in any mobile network that allows the separation of an access network portion from a service network portion.

[0048] Moreover, those skilled in the art will recognise that while a mobile terminal capable of supporting both public mobile network radio communication, such as GSM, and unlicensed radio communication, is convenient for the subscriber, this is not necessary. The subscriber may instead use a separate unlicensed radio handset for accessing the public mobile network via the fixed access network portion 10' provided by a home base station and home base station controller. Such a handset would include all the layer functions in the described combination mobile terminal 1, but exclude those layers relating specifically to the licensed radio. A conventional mobile terminal for use in the public mobile network would then have to be used outside of the coverage of a home base station and handover between the two access networks would not be supported as described above.

#### Claims

1. In an access network arranged to communicate with a core network portion of a public mobile telecommunications network, said access network including a base station adapted to communicate over an unlicensed radio interface with at least one mobile terminal (1) and to communicate through a fixed broadband network (106) with an access control part (105) of said access network (10) connected to said core network (20), a method of connecting said base station with said access control part over said fixed broadband network, **characterised by** establishing a connection with a first port of the access control part on said fixed network, sending an attachment request to said first port including a first predetermined device identifier, receiving a request acknowledgement including a connection interface address on said fixed network and a base station identifier, releasing said connection with said first port, establishing a connection at said fixed network interface address using said base station identifier.

2. A method as claimed in claim 1, further **characterised by** the step of:

55 sending a connection maintenance message to said received interface address within a predetermined time interval to maintain said connec-

tion established.

3. A method as claimed in claim 2, further **characterised by** the step of:

receiving data representing said time interval from said access control part with said request acknowledgement.

10 4. A method of registering a base station that is adapted to communicate with mobile terminals through an unlicensed radio link with an access network controller that provides access to a core network of a public mobile telecommunications network through a fixed network interposed between said base station and said access network controller, said method including the steps of:

receiving a connection request including an unlicensed radio device identifier from said base station through said fixed network, authenticating said unlicensed radio device identifier, selecting a base station identifier and reserving at least one communication port on said fixed network for communication with said base station, transmitting a response to said connection request including an interface address for said reserved port and said base station identifier, checking for said base station identifier in communication requests through said interface address and reserved port prior to permitting communication.

35 5. A method as claimed in claim 4, further **characterised by**:

communicating a connection maintenance time interval to said base station, and releasing said reserved port if a connection is not established within said time interval.

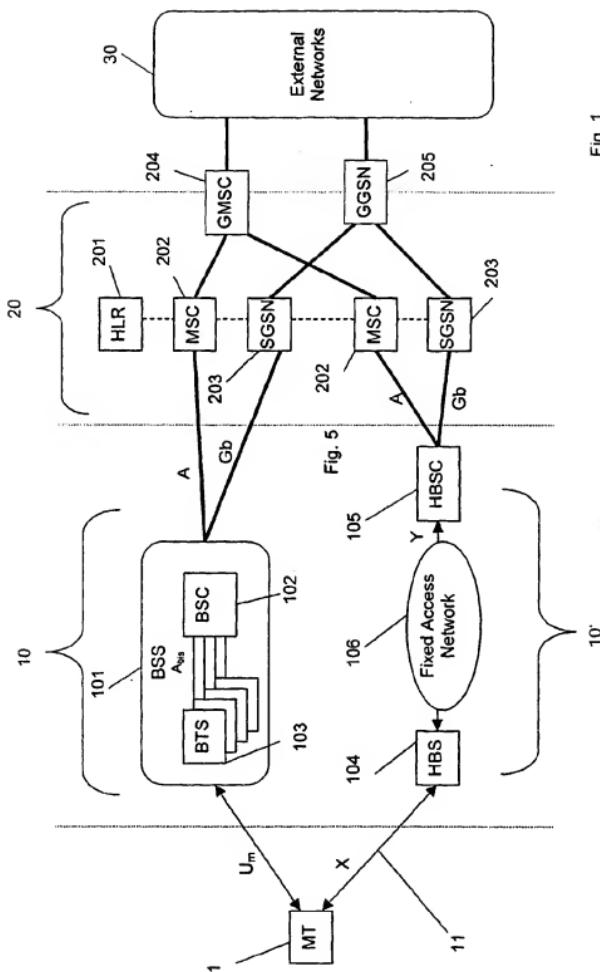


Fig. 1

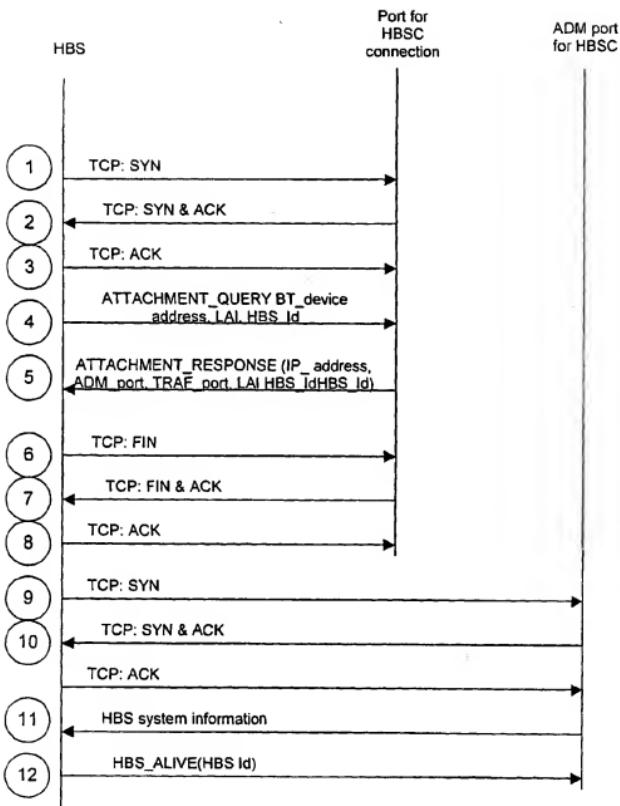


Fig. 2

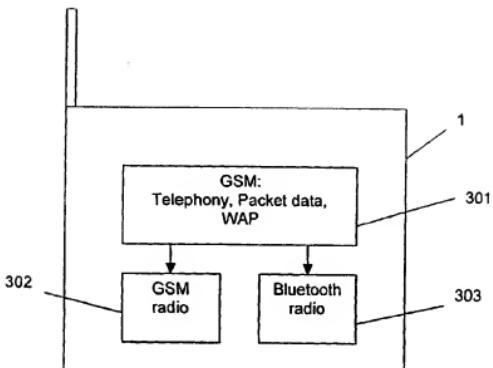


Fig. 3

IMSI <sub>1</sub>	HBS_Id <sub>1</sub>
IMSI <sub>2</sub>	HBS_Id <sub>2</sub>
⋮	
IMSI <sub>n</sub>	HBS_Id <sub>n</sub>

1051

Fig. 7

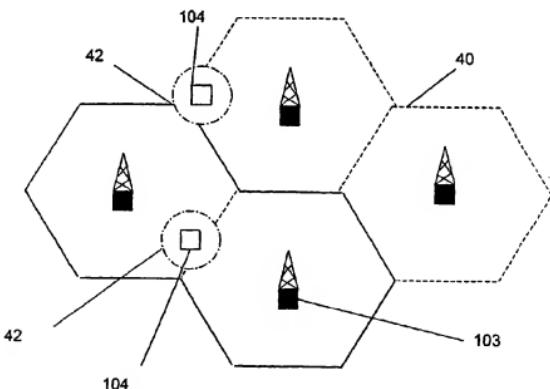


Fig. 6

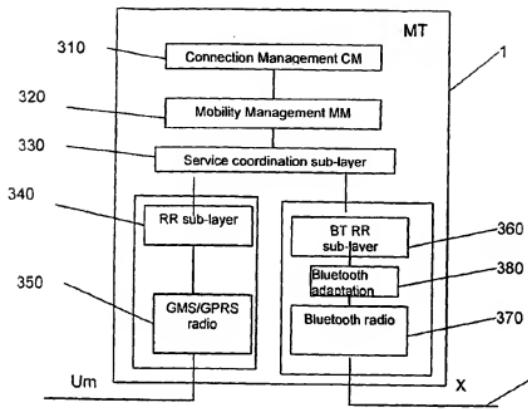


Fig. 4

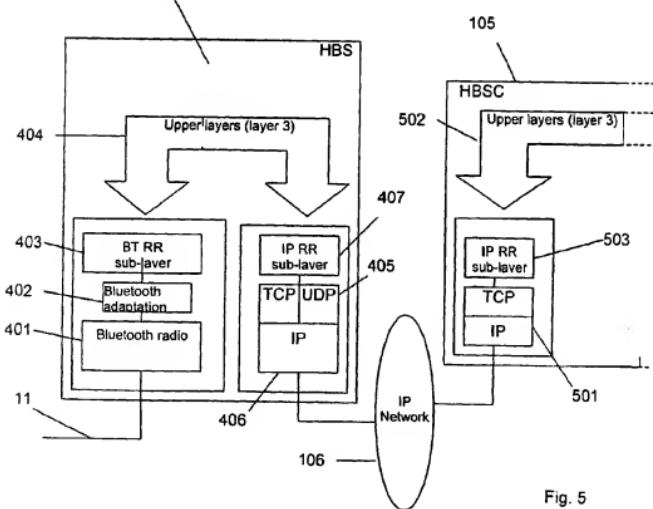


Fig. 5

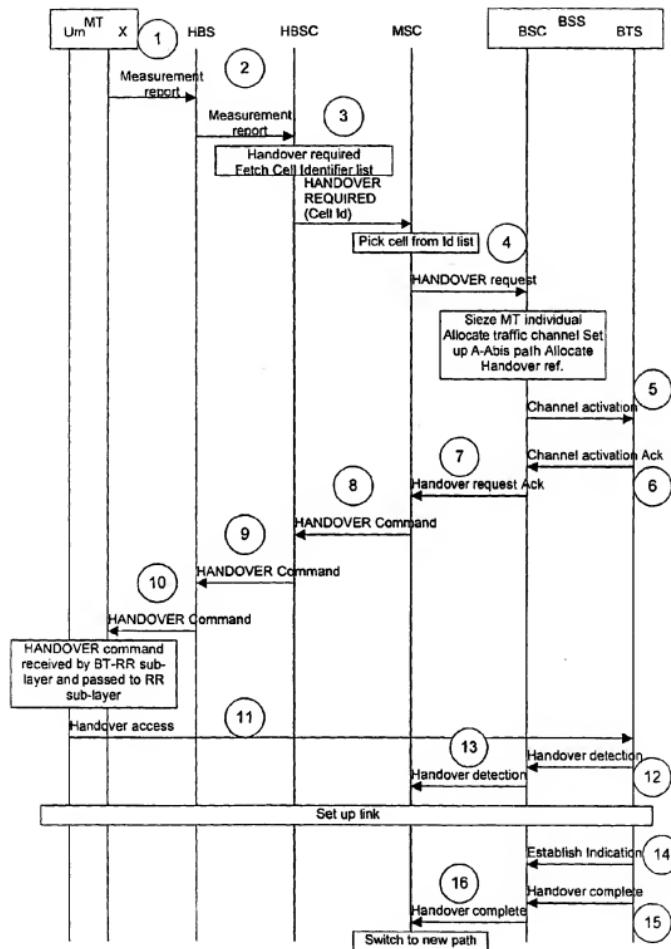


Fig. 8

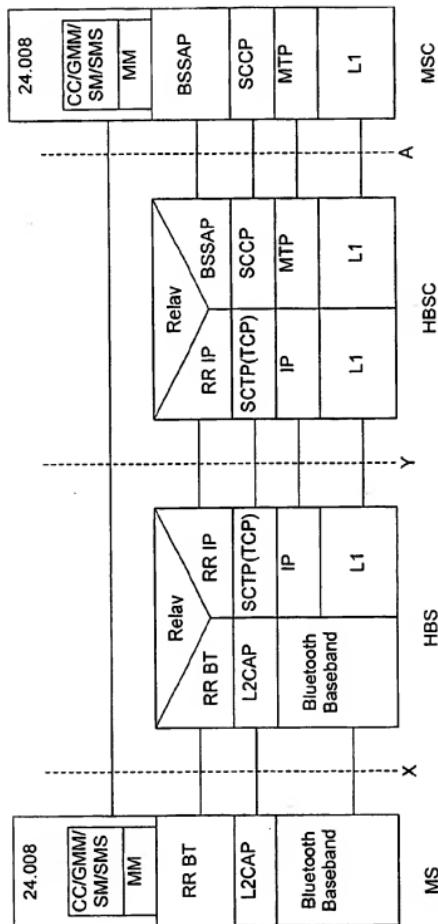


Fig. 9

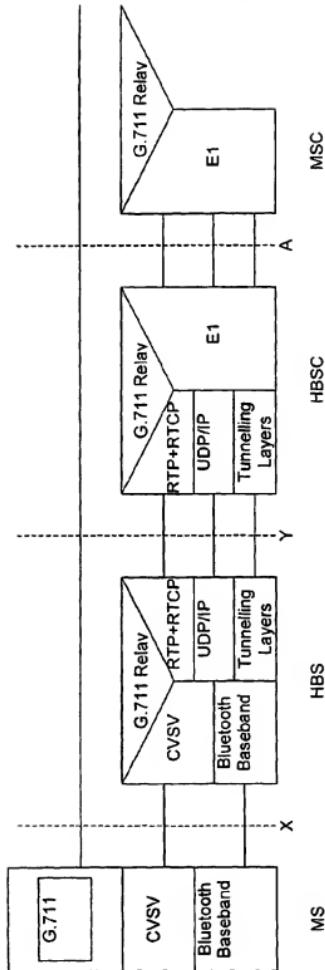


Fig. 10



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.)
A	WO 99 35800 A (BERGENWALL MARTIN ;NOKIA TELECOMMUNICATIONS OY (FI); PIRKOLA JUHA) 15 July 1999 (1999-07-15) * page 1, line 7 - line 11 * * page 3, line 4 - line 13 * * page 4, line 20 - page 5, line 4 * * page 6, line 18 - page 7, line 9 * * page 8, line 30 - line 31 * -----	1-5	H04Q7/30 H04L12/28
A	WO 99 56486 A (NOKIA TELECOMMUNICATIONS OY ;MATTURI JUHA (FI); PIETILAE JUKKA (FI) 4 November 1999 (1999-11-04) * page 3, line 31 - line 32 * * page 10, line 22 - line 31 * -----	1-5	
The present search report has been drawn up for all claims			
Place of search	Date of compilation of the search	Examiner	
THE HAGUE	23 July 2003	Heinrich, D	
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone	T : theory or principle underlying the invention		
Y : particularly relevant if combined with another document of the same category	E : equivalent document, but published on, or after the filing date		
A : document of general interest	D : document cited in the application		
C : non-patent literature	L : document cited for other reasons		
P : intermediate document	B : member of the same patent family, corresponding document		

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 03 01 5799

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-07-2003

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9935800	A	15-07-1999	FI 980024 A AU 1880099 A CN 1288528 T EP 1058989 A2 WO 9935800 A2 JP 2002501333 T NO 28603488 A	08-07-1999 26-07-1999 21-03-2001 13-12-2000 15-07-1999 15-01-2002 06-07-2000
WO 9956486	A	04-11-1999	FI 980951 A AU 755464 B2 AU 3712999 A CN 1266599 T EP 8995327 A2 WO 9956486 A2 JP 2002512767 T NO 996535 A US 6574208 B1	30-10-1999 12-12-2002 16-11-1999 13-09-2000 26-04-2000 04-11-1999 23-04-2002 29-12-1999 03-06-2003